GHub: Bridging ice sheet data and model communities

Jeanette Sperhac, Erika Simon†, Denis Felikson†, Renette Jones-Ivey, Elliot Snitzer, Kristin Poinar*, Jason Briner*, Sophie Nowicki*, Justin Quinn††, Beata Csatho*, Abani Patra‡

Center for Computational Research (CCR) and *Department of Geology, State University of New York at Buffalo; †NASA Goddard Space Flight Center; ††NASA Jet Propulsion Laboratory; ‡Tufts University

https://theghub.org

The GHub science gateway is a new collaboration space for scientists, educators, and students working to understand our planet's ice sheets. GHub bridges the gap between the observational and numerical modeling ice sheet communities with interpretive tools and observational datasets of past and present ice sheet states that will ultimately improve predictions of sea level rise. It provides a common point of engagement for the ice sheet community. During our pilot, we developed 8 computational tools and hosted the 7TB Ice Sheet Modeling Intercomparison Projects (ISMIP6) dataset. Now in the first year of a five-year grant, our growing user base is 78 members strong.

GHub Goals

- Python and R Jupyter Notebooks, online computational tools, hosted codes
- Hosted ice sheet and paleoglaciology datasets, accessed via Globus
- High-performance computing (HPC) access
- Tools for seamless use of large datasets hosted by data partners such as National Snow and Ice Data Center (NSIDC)
- User-contributed computational tools and resources
- Resources for education, outreach, and workshops

Community Codes

The GHub project hosts community codes such as NASA Goddard's Cryosphere model Comparison tool (CmCt), NASA JPL's Ice-sheet and Sea-level System Model (ISSM), and Surface Elevation Reconstruction and Change (SERAC). Codes will be open-sourced where possible. Users can run provided tools, or build tools utilizing these hosted codes and run them on HPC resources.

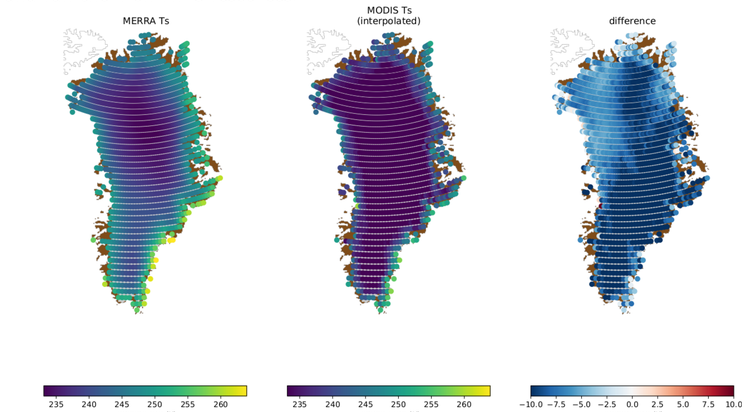

Figure 1: GHub *modgrnld* tool plots Greenland ice surface temperature from MERRA-2 data (modeled; left), a MODIS temperature product (observed; middle), and difference (right). (Felikson, Snitzer)

Hosted Datasets and Model Products

GHub will host paleoclimatologic ice sheet data, contemporary ice sheet data, and Ice Sheet Modeling Intercomparison Projects (e.g. ISMIP6) models, all crucial for shedding light on ice sheet sensitivity to climate change. Featured datasets will include:

- Paleoglaciology data: relative sea level and ice margin mapping
- Contemporary data: time series data of elevation changes, fused and characterized using the Surface Elevation Reconstruction and Change (SERAC) method
- Models generated by ISMIP6

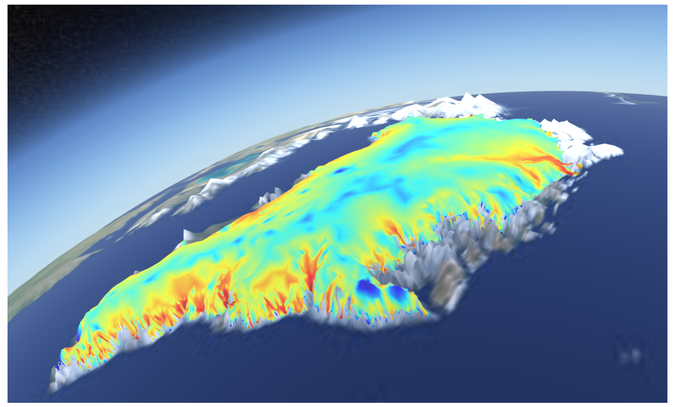

Figure 2: Ghub is partnering with NASA's Virtual Earth Systems Laboratory (VESL) to display Ghub datasets. Here, Greenland ice sheet velocity, m/yr, modeled using NASA JPL's online ISSM tool. Velocities range from dark blue (0 m/yr) to dark red (3500 m/yr). (Quinn)

Our Cyberinfrastructure

GHub's computational tools run right in the user's browser with no extra code installs. The underlying infrastructure spins up Docker containers in order to run tools such as Jupyter Notebooks or Linux workspaces. Tools can utilize remote data sources for input, and remote high-performance computing resources for computation. Docker containers and software installations are maintained by gateway administrators.

GHub users develop, share and release their own tools and documentation on the gateway, using compilers, source control, and a guided tool development workflow. Users can also submit tool reviews, add to wishlists for future enhancements, and submit questions to tool developers. GHub uses the open-source HUBzero platform.

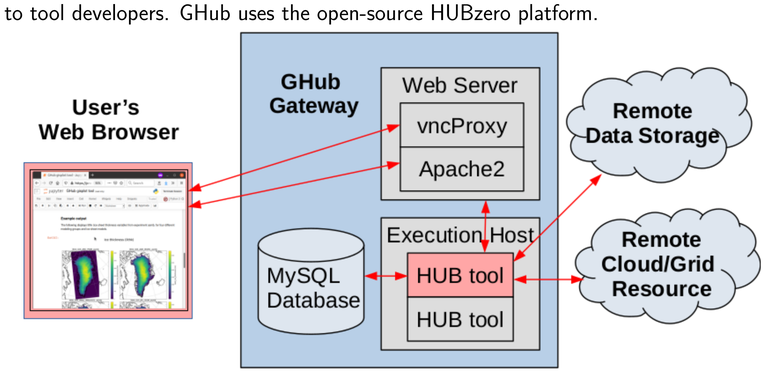

Figure 3: Summary schematic of the HUBzero platform architecture underlying GHub. Tools run in Docker containers and can run jobs on outside computing resources and access remote data storage.

Community Benefits

How can GHub help the ice sheet community?

- Shared computing resources and standardized workflows;
- Broadened access and faster turnaround to scientific results;
- Reuse and sharing of modeling experiments and data analysis tools; and
- Centralized datasets, documentation, examples, and scholarship.

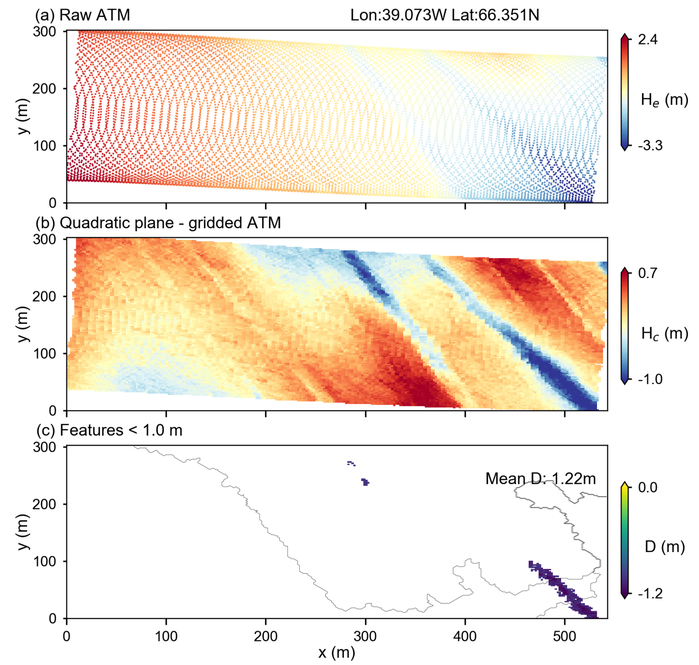

Figure 4: GHub's crevasse detection workflow uses high performance computing resources to run a detection algorithm on airborne laser altimeter data with user-selected parameters. (Jones-Ivey, Poinar)

Outreach with GHub

Since 1998, CCR has offered the Eric Pitman Summer Workshop in Computational Science, a two-week curriculum of programming and problem solving for high school students. Our 2022 workshop will feature lectures by GHub scientists, and ice sheet calculations, collaborative projects, and data hosted on the GHub gateway.

Contact Us

https://theghub.org

Jeanette Sperhac (co-I, UB CCR): jsperhac@buffalo.edu

Jason Briner (PI, UB Geology): jbriner@buffalo.edu

University at Buffalo
Center for Computational Research